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Forty Percent of the Nation's Coal: Development of the Northern Plains

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Development of the coal resources of eastern Montana may be the most controversial issue that has faced the state of Montana in recent years. The issues involved are complex and many-sided. This complexity is compounded by the fact that decisions influencing the development are routinely being made in public, private, and governmental sectors without adequate knowledge of the effects of the decisions. This paper will not enlarge the data base upon which decisions should be made. Detailed research plans are presently being formulated to study the potential impacts associated with coal development, but some answers are still years away. We simply review the current status of coal development in Montana, speculate about some possible technological configurations for future development, and review some of the potential impacts which could be associated with the development.

Although coal development in eastern Montana may seem to be a new issue, the vast coal resources of the Fort Union Basin have been known for over 150 years. Lewis and Clark noticed the presence of coal as they traveled up the Missouri in 1805. George Custer, rambling through the region in the 1860s and 1870s, also noted large coal deposits and speculated on their economic importance. Custer lost the opportunity to capitalize on the coal resources of the Big Horn country and it was another 50 years before coal was extensively mined there. The first major strip mine was opened in 1923 by the Northern Pacific Railroad and the Foley Brothers of Minneapolis at Colstrip, 35 miles southwest of Forsyth, Montana. The coal produced at this mine was used to power Northern Pacific steam locomotives and reached a peak of 2.5 millions tons in 1943. Production from the Colstrip mine slowly decreased after 1943 because of conversion from steam to diesel locomotives, and the mine finally closed in 1957. Except for a small strip mine near Savage, surface coal mining was nonexistent in eastern Montana until large scale development began again in the late 1960's. Figure 1 shows the historic coal production in Montana. Recent coal production has been located entirely in eastern Montana.

The coal region of eastern Montana is located in the Fort Union Basin which encompasses parts of four states and Saskatchewan as shown in Figure 2. The coal region of eastern Montana is detailed in Figure 3 and Table 1. The Fort Union Basin contains nearly 40 percent of the coal reserves of the United States—an estimated 1.3 trillion tons. The strippable reserves in Montana alone are estimated to be over 31 billion tons.

According to the first annual report of the Montana Environmental Quality Council, the coal lands of eastern Montana can be divided into three general geographic regions—the Beartooth forelands, the Ponderosa parklands, and the Big Dry. The Beartooth forelands contain gentle uplands, rolling hills and deeply eroded stream channels that form precipitous bluffs and buttes. The climate is characterized by sunshine, low relative humidity, low precipitation, and wide daily and seasonal temperature variation. To the north and east of the Beartooth forelands is a ponderosa parkland savanna. Over one-half million acres of State and National forest lands are located in the region. The topography of the pine parkland region reflects the nature of the underlying sedimentary strata; clinker capped ridges and sandstone outcrops characterize the area. Again, further to the north and east, the pine parklands merge into the "big dry". Although water is not abundant in the "big dry" region and both summer and winter temperatures are often extreme, it is by no means an unproductive land. Large cattle ranches and dry land farms exist throughout the region. As of 1971, there were over 1.5 million beef cattle on eastern Montana ranches.

In general, one might say that the Fort Union region has changed little in the time of man. Agriculture is the primary industry in the region and the human population is sparse. Much of the region has a population density of about one person per square mile. There are few cities and Billings and Miles City are the population and economic centers.

Current Coal Production

The coal industry in eastern Montana has expanded rapidly in recent years. There are presently four strip mines operating in the coal region. The Western Energy Company, a wholly owned subsidiary of the Montana Power Company, operates a mine at Colstrip at the site

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of the old Northern Pacific Mine. This mine resumed production in 1968 and by 1972 reached an annual production of 5.5 million tons. According to the 1972 Montana Power Annual Report, several long-term contracts become operative in 1975 and a substantial increase in production will occur. Montana Power Company officials have indicated that the company will produce 12 to 13 million tons of coal a year by 1980 at this site.

The Peabody Coal Company, a subsidiary of the Kennecott Copper Company, also operates a strip mine near Colstrip. Peabody began operation at the Big Sky Mine south of Colstrip in 1969. Production from this mine was 1.5 million tons in 1970 with long-term contracts calling for increases up to 3.5 million tons in 1974. The coal mined at the Big Sky Mine is shipped by unit train to Minneapolis for use by the Minnesota Power and Light Company.

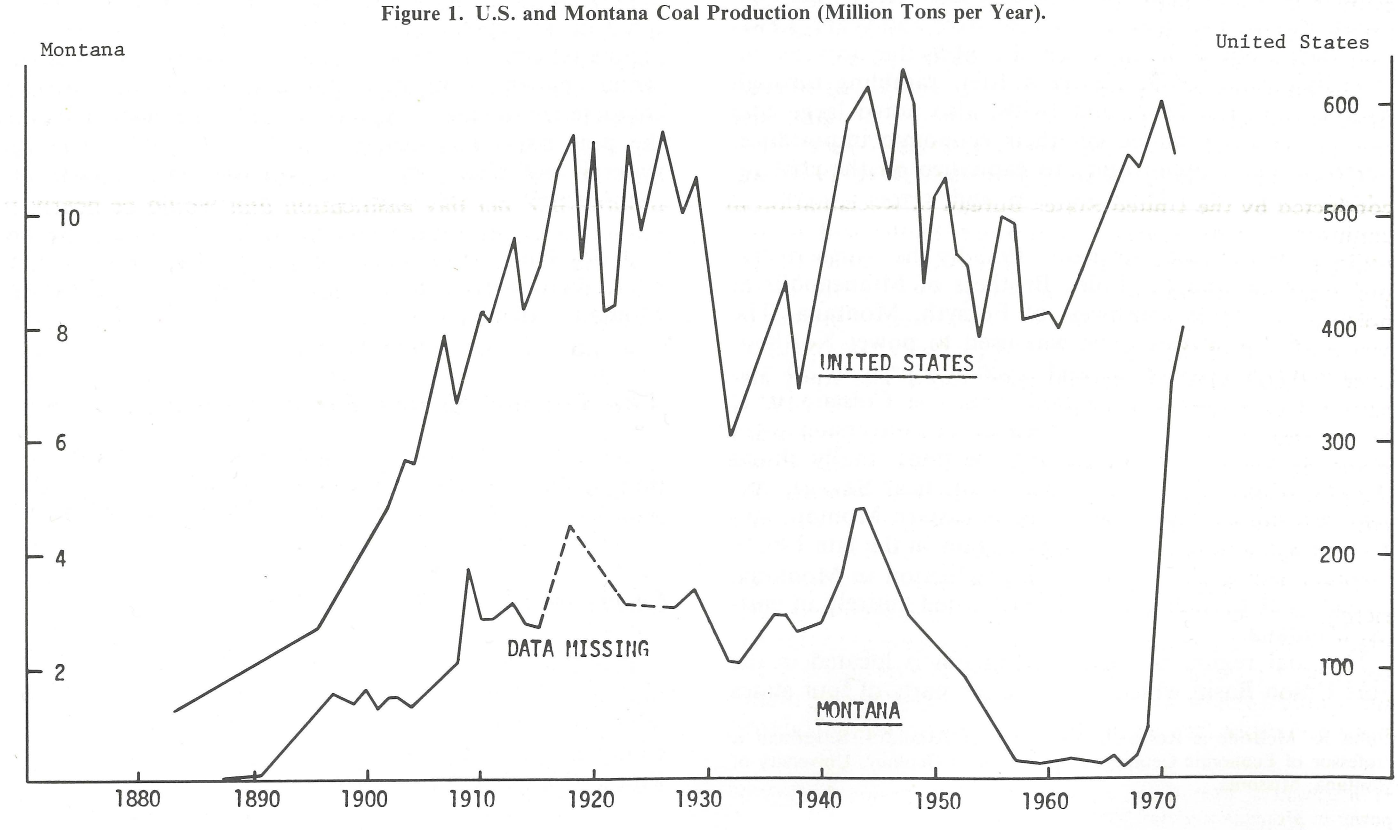
The Decker Coal Company, a joint venture between the Pacific Power and Light Company and Peter Kiewit Sons' Company, operates a strip mine near Decker. This company was formed in 1970 and production began in the fall of 1972. 1973 production is expected to be approximately 4 million tons. The coal is shipped by unit train to Havanna, Illinois, and then by barge to Chicago for use in Steam electric generation by the Commonwealth Edison Company. In addition, the Decker Coal Company recently announced the sale of 180 million tons of coal to the Detroit Edison Company for coal-fired steam electric generation in Michigan. The coal will be delivered over a 26-year period beginning in 1976 and annual shipments will reach 7 million tons.

The Knife River Coal Company, a subsidiary of the Montana/Dakota Utilities Company, has operated a small strip mine near Savage since 1957. The output from this mine is slightly over 300,000 tons per year and is used to fuel the Montana/Dakota Utility steam electric generating plant at Sidney, Montana.

The Westmorland Resources Corporation, a partnership of Kewanee Oil Company, Morrison-Knudsen Company, Penn Virginia Corporation and the Westmorland Company, is planning an extensive strip mining operation on Sarpy Creek, south of Hysham. The coal leases for this development were obtained from the Crow Indian Tribe and are located on ceded land to which the Crow tribe retained mineral rights. Westmorland Resources has applied to the Department of State Lands for a mining permit and is currently assembling a drag line and loading equipment at the mine site. The Burlington Northern Railroad is constructing a 36 mile rail spur to the site to haul the coal in unit trains to several mid-western utilities. Westmorland has executed contracts providing for the sale of 76.5 million tons of coal over a 20-year period beginning March 1, 1974.

In addition to the existing and planned strip mine operations, there is also considerable coal leasing activity in eastern Montana. According to the Northern Plains Resources Council, over 601,000 acres of land were under lease in the 12 counties of eastern Montana as of March 1, 1973. Consol, Norsworth-Reger, HFC Oil Company, Sentry Royalty Company, Western Energy Company and Westmorland Resources each have over 50,000 acres under lease. The Northern Plains Resources Council lists a total of 47 individuals and corporations holding coal leases in eastern Montana. Major coal lessors include the United States government through the Bureau of Land Management, the state of Montana, the Crow and Northern Cheyenne tribes, and the Burlington Northern Corporation. A temporary moratorium on further coal leasing by the Bureau of Land Management is in effect, but private coal leasing activity in the area has not subsided.

Figure 1. U.S. and Montana Coal Production (Million Tons per Year).



Future Coal Use

The continued large scale development of eastern Montana coal could occur through several different technologies. The coal could be stripmined and:

1) shipped out by unit train or slurry pipeline;
2) converted to electric power at the mine mouth, and the electric power transmitted out of the region;
3) gasified or liquified and transmitted by pipeline to load centers;
4) or it could be hydrogenated in place, without mining, and then transmitted by pipeline to load centers.

Coal shipment and mine mouth generation are already occurring in eastern Montana and gasification may soon follow. The technology for coal liquefaction is not quite economic and in-place hydrogenation is still quite speculative; however, the U.S. Bureau of Mines will start a field hydrogenation experiment in Wyoming this year.

All of these technologies will have an impact on the biophysical and socio-economic environment. The combined impact of large scale development of several technologies could be enormous. The severity of the potential socio-economic and environmental impacts of the various energy conversion technologies can be envisioned simply by considering the size of the facilities. The 700 MW (Megawatt)* steam electric generating plant presently under construction at Colstrip, Montana, by the Montana Power Company and Puget Sound Power and Light Company, has a projected total cost of $183,000,000. The plant construction crews are expected to peak at over 800 men. In addition, the Montana Power Company and several other Pacific Northwest utilities have recently applied for a certificate of environmental compatability and public need under the Montana Utility Siting Act of 1973 to construct an additional 1400 MW coal-fired electric generating plant at Colstrip. This facility, along with the necessary transmission lines and water pipeline, has an estimated cost of over 368 million dollars. It will be necessary to strip mine approximately 6 million tons of coal per year to fire this power generation complex alone.

The enormity of the potential for development of coal-fired steam electric generation in eastern Montana also can be assessed from the North Central Power Study (NCPS). The NCPS, completed in the fall of 1971, was conducted by the United States Bureau of Reclamation in conjunction with several midwestern public and private utilities. The purpose of the study was to promote the coordinated development of electric power supply in the north central United States. The study located proven reserves of coal in the Fort Union region adequate to supply over 200,000 MW of thermal generation. The study also assumed an ultimate development level of 53,000 MW to be generated by coal-fired steam electric generation plants in the region. In addition, the Bonneville Power Administration has suggested that demands from the Pacific Northwest for electric power generated in the Fort Union region may reach 31,000 MW by 1990.

There has been some speculation that a uranium enrichment plant may be located in eastern Montana. This plant would concentrate U^{235}, a fissionable uranium isotope, by a gaseous diffusion process. The enriched uranium would then be used as a fuel for nuclear power plants, not necessarily located in the Fort Union region. The total

*1 megawatt = 1000 kilowatts; current total production of electrical power in Montana is about 1800 megawatts.

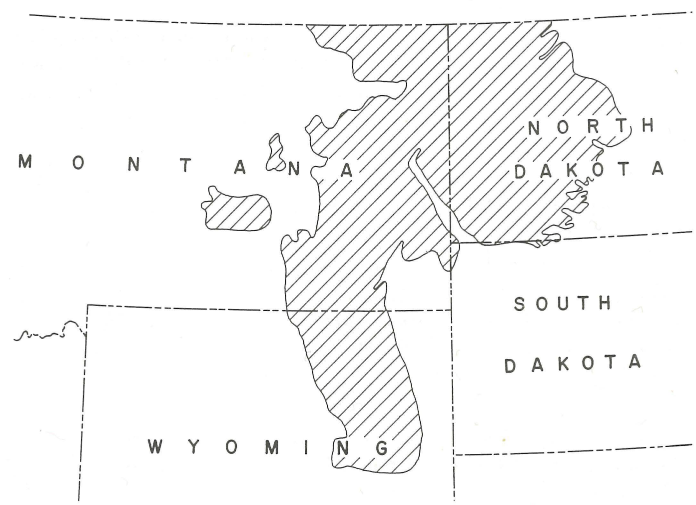


Figure 2. The Fort Union coal formation in Montana, Wyoming, North Dakota, and South Dakota.

cost of a uranium enrichment plant would be over $2 billion. A construction crew of 6,000 to 8,000 men would be necessary to build the plant and the operating crew would number over 1,000. A 2,500 MW coal-fired steam electric generating plant would be required to power the enrichment plant. By comparison the Colstrip facility, as currently planned, would generate 2,100 MW in total. Several companies have announced interest in a uranium enrichment operation including Reynolds Metals, Westinghouse, and Union Carbide.

The possibility of coal gasification in eastern Montana has also aroused considerable interest. Coal gasification is a process in which coal is converted to synthetic high BTU, pipeline quality natural gas. The process of converting coal into low BTU gas has been known for many years and several small plants are operating in Europe and Africa. High BTU gasification plants of the size conceived for eastern Montana have never been built, although the construction of a 250 million SCF* per day coal gasification plant may soon commence near Farmington, New Mexico. A 250 million SCF per day gasification plant with its requisite mine and pipelines would cost well over 400 million dollars to construct and would require over 700 men for operation. The coal required for a single 250 million SCF per day gasification unit would be nearly 10 million tons per year. Consolidation Coal Company, the Colorado Interstate Gas Company, Northern Natural Gas, Westmorland Resources Company, and HFC Oil Company all have expressed interest in building coal gasification plants in eastern Montana.

The United States Energy Picture

There is certainly a great potential for large-scale coal development in eastern Montana. We must now consider whether this potential will indeed become a reality. The potential for development of eastern Montana coal resources depends essentially on two factors—energy demand and the technological methods for meeting this demand.

Electric power consumption in the United States has been increasing at about 7 percent per year, doubling in 10 years. Total energy demand in the United States has

*SCF = Standard Cubic Feet measured at normal pressure (1 Atm.) and room temperature (25° C).
Montana consumes about 300 million SCF of gas per day.

Table 1. Strippable subbituminous and lignite coal fields, eastern Montana.

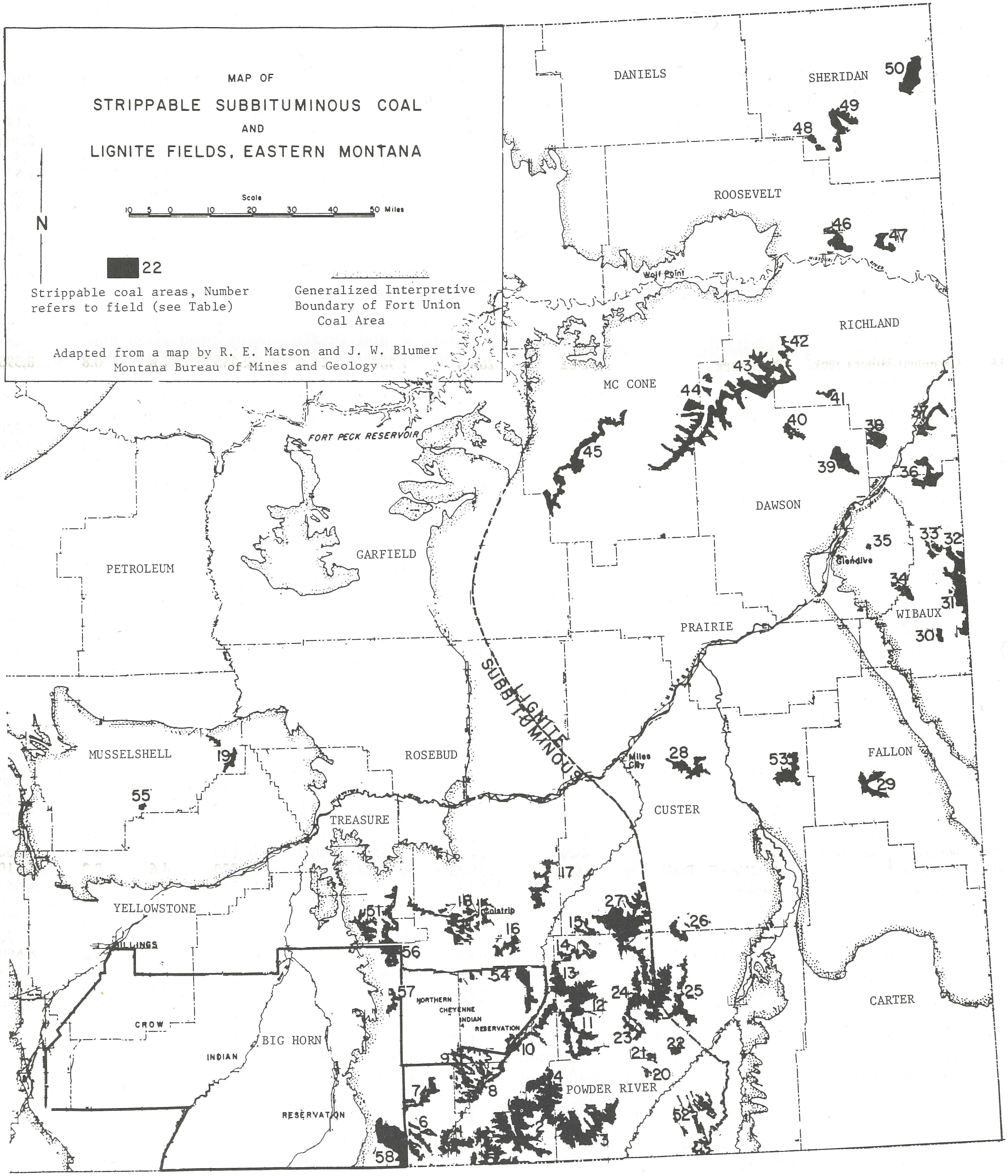
No. on map	Name of field	Coal bed	Thickness in feet	Est. reserves in millions of tons (G, good; F, fair; R, rough)	Acreage	Square miles	Average tons/acre	Ash[1]	Sulfur[1]	Btu[1]
1	Decker[2]	Anderson-Dietz	20-89	1,947 F	25,472	39.8	76,435	4.0	0.4	9,652
2	Hanging Woman Creek	Anderson-Dietz	12-35	3,099 G	78,208	122.2	39,625	6.4	0.3	8,446
3	Moorhead	Anderson-Canyon	6-30	1,979 G	49,474	77.3	40,005	5.3	0.3	8,296
4	Poker Jim Lookout	Anderson-Dietz	15-58	573 G	8,448	13.2	67,825	5.7	0.4	7,804
5	Roland[2]	Roland	10	315 F	17,797	27.8	17,700	5.6	0.3	7,637
6	Squirrel Creek	Roland	10	130 F	7,345	11.5	17,700	5.6	0.3	7,637
7	Upper Rosebud[2]	Anderson	20	220 F	6,212	9.7	35,400	4.4	0.4	8,391
8	Birney	Brewster-Arnold	18	321 G	12,127	18.9	26,470	5.9	0.4	8,872
9	Canyon Creek	Wall	30-60	200 F	2,825	4.4	70,800	4.6	0.3	9,090
10	Poker Jim-O'Dell Creek	Knoblock	10-40	770 G	16,100	25.2	47,825	4.9	0.3	8,850
11	Otter Creek	Knoblock	20-60	1,041 G	20,297	31.7	51,290	4.7	0.4	8,466
12	Ashland	Knoblock	25-70	2,595 G	27,315	42.7	95,000	4.8	0.2	8,371
13	Cook Creek[2]	Sawyer	8-12	53 F	2,994	4.7	17,700	5.1	0.7	7,917
14	Beaver Creek[2]	Knoblock	12-22	160 F	5,317	8.3	30,090	7.0	0.5	8,146
15	Liscom Creek[2]	Knoblock	8	75 F	5,297	8.3	14,160	8.7	0.6	7,900
16	Greenleaf-Miller Creek[2]	Knoblock	12-22	260 F	7,962	12.4	32,655	7.8	0.8	8,395
17	Sweeny-Snyder	Terret	18	312 G	10,523	16.4	29,650	5.8	0.7	8,170
18	Colstrip	Rosebud	25	1,440 G	32,850	51.3	43,835	8.4	0.7	8,700
19	Carpenter Creek[3]	Carpenter	5-8	50 F	3,211	5.0	14,015			
20	Fire Creek[2]	Pawnee	16-20	40 G	1,255	2.0	31,870	6.0	0.4	7,650
21	Upper Cache Creek[2]	Pawnee	20	40 G	1,130	1.7	35,400	6.0	0.4	7,650
22	Lower Cache Creek[2]	Broadus	12	10 G	470	0.7	21,275	7.2	0.3	7,438
23	Sonnette[2]	Pawnee	20	206 G	5,819	9.1	35,400	6.6	0.7	7,334
24	Pumpkin Creek	Sawyer	30	1,900 G	41,930	65.5	45,315	7.9	0.5	7,457
25	Broadus	Broadus	5-26	737 G	18,904	29.5	38,985	7.2	0.3	7,438
26	Sand Creek	Knoblock	15-32	278 G	5,958	9.3	46,660	6.7	0.3	7,340
27	Foster Creek	Knoblock	8-16	1,200 G	58,000	90.6	20,690	7.7	0.5	7,605
28	Pine Hills	Dominy	17	280 G	9,046	14.1	30,950	7.2	0.5	7,293
29	Lame Jones[3]	Dominy	6-10	150 R	10,593	16.6	14,160			6,020
30	Lamesteer[3]	Harmon(?)	6-10	35 R	1,978	3.1	17,700			6,332
31	Wibaux[3]	C	5-40	643 G	18,518	29.9	34,720	7.9	0.9	6,050
32	Little Beaver[3]	C	8-15	134 R	8,445	13.2	15,865			
33	Four Buttes[3]	C	5-20	91 G	5,180	8.1	17,570			6,140
34	Hodges[3]		6-8	10 R	807	1.3	12,390			
35	Griffith Creek[3]		8-12	10 R	568	0.9	17,700			
36	Smith-Dry Creek[3]	G	8-12	150 R	8,475	13.2	17,700			
37	O'Brian-Alkalie Creek[3]		8-12	150 R	8,475	13.2	17,700			
38	Breezy Flat[3]	Pust		200 F	7,062	11.0	30,090	6.7	0.5	6,660
39	Burns Creek[3]	Pust	12-20	200 R	7,062	11.0	30,090			
40	N.F.Thirteen Mile Creek[3]	Pust	10-43	225 F	5,085	8.0	44,250			6,880
41	Fox Lake[3]	Pust	7-17	46 F	2,166	3.4	21,240			6,880
42	Lane[3]	Lane	7	561 R	44,582	69.7	12,390			7,150
43	Carroll[3]	Carroll	6	345 R	29,780	46.5	11,584	5.5	0.3	7,400
44	Redwater River	S	9-21	642 G	24,181	37.8	26,550	6.1	0.4	7,400
45	Weldon-Timber Creek	S	8-20	724 G	25,565	40.0	28,320			7,660
46	Fort Kipp[3]	Ft. Kipp-Ft. Peck	5 & 8	331 G	14,500	22.7	22,830	4.6	0.2	6,110
47	Lanark[3]	Lanark	7	100 G	3,531	5.5	12,390	6.3	0.4	6,853
48	Medicine Lake[3]		9	58 F	3,740	5.8	15,510	7.2	1.0	6,870
49	Reserve[3]		7	246 F	18,231	28.5	13,495	7.6	0.4	6,599
50	Coal Ridge[3]	Coal Ridge	10	150 F	19,200	30.0	17,700	7.5	0.4	5,830
51	Sarpy Creek[3]	Rosebud-McKay	10-35	1,500 F	42,373	66.2	35,400	6.5	0.5	8,600
52	East Moorhead	Cache	9-26	541 G	15,983	25.0	33,850	7.2	0.5	7,148
53	Knowlton	Dominy	8-31	798 G	15,338	24.0	52,030	4.1	0.4	6,689
54	Cheyenne Meadows[4]	Knoblock	30-65	1,200 G	13,560	21.2	88,500	4.1	0.4	8,400
55	Charter[3]	Mammoth	5-14	60 G	3,210	4.0	17,700			
56	Little Wolf[4]	Rosebud-McKay	15-35	314 R	7,411	11.8	42,370			
57	Jeans Fork[4]		10-20	90 R	3,800	5.9	23,685			
58	Wolf Mountains[4]		20-50	1,922 R	31,000	48.4	62,000			
		TOTAL		31,857	882,685	1,379.2				

[1] "As received" basis (where more than one sample available, figures given are average figures).
[2] Areas being re-evaluated by MBMG.
[3] Areas where MBMG does not have original data for reserve calculations.
[4] Areas on Indian Reservations–Acreages given are the total lease area.

By Robert E. Matson and John W. Blumer, MBMG

Note: Sulfur and ash concentrations are of interest for air pollution control. The higher the sulfur and ash concentrations, the dirtier the coal. BTU content refers to the heat value of the coal. The higher the BTU content, the higher the heating and monetary value.

Figure 3.



Can long term reclamation be demonstrated on the

ment in eastern Montana

also been increasing at the rate of 4.5 percent per year. In order to project the magnitude of the eastern Montana coal development, it is necessary to anticipate an energy demand that considers both regional and national energy flows and sources. It is easy to project a short-term energy supply; the problem arises in accurately projecting an energy demand. Accurate long-term energy demand projections are extremely difficult to make, particularly since energy demand is price sensitive. This is particularly unfortunate since an accurate demand forecast is essential for proper energy planning. One can observe, however, that it is unwise to base energy planning solely on demand projections extrapolated from recent energy growth rates, as such projections do not usually consider market saturation, new technology or price sensitivity.

The second factor affecting the potential coal development in eastern Montana is the technology used to meet the energy demand. Descriptions of potential energy sources and technologies for energy conversion are common in the popular and scientific literature. Unfortunately, most of the exotic technologies and sources are still in the speculative or early developmental stages. Oil and natural gas are presently our primary fuel sources, accounting for approximately 77 percent of the energy used in the United States. Coal currently amounts to 18 percent of the U.S. energy production, hydropower 4.4 percent, and nuclear power generation 0.6 percent.

The United States' known reserves of oil and natural gas are more severely limited than other places in the world and alternative energy sources will be increasingly needed. In fact, the United States is already importing 30 percent of its petroleum to meet current demands and may be importing an even larger percentage in the future. The economic, political and social implications of reliance on imported oil are certainly controversial, and are predicted by some to be disastrous with respect to national security and balance of trade. Hydroelectric and nuclear power may also have a somewhat limited role in meeting the United States energy demand. Most of the remaining hydroelectric sites are located in national parks, scenic or other recreational areas and are not likely to be developed, and expansion of operating sites has a limited capability. Even this potential may not be developed because of delays in federal funding for new turbine installations.

The installation of nuclear power plants has lagged behind schedule and expectation; and technical, environmental, and safety factors may preclude rapid expansion of nuclear power, including an acceptable fast breeder reactor. If the fast breeder reactor is not developed, the relatively cheap, easily locatable United States uranium reserves will be rapidly consumed, possibly by 1990. Other energy sources such as geothermal, solar, wind, and waste gasification are likely to be developed in the near future; however, with the possible exception of the California geothermal fields, they are likely to be used as small, local community energy sources rather than for massive, large scale developments. This is not to suggest that the development of alternative local energy sources is not important. Local sources minimize transmission losses and often do not require enormous capital expenditures. Local source energy development should be greatly expanded where possible. However, political and economic questions will hinder development in the near future.

Hence one can conclude that coal will play a larger role in United States energy production. All estimates of the United States coal reserves suggest that coal will be readily available well into the 21st Century and probably for centuries after. Almost all of the coal currently mined in the United States is used for industrial, metallurgical, and electric utility purposes. More than 80 percent of the current U.S. coal production comes from the Appalachian and Midwest regions. Unfortunately most of this eastern coal has a high sulfur content and creates air pollution problems upon combustion. The coal in eastern Montana is relatively low in sulfur content by comparison. In order to meet air pollution regulations, many coal users are beginning to burn western low sulfur coal. This is evidenced by shipment of Montana coal 1,000 miles into the coal producing regions of the Midwest.

The United States coal production is expected to rise because of the increasing demand for energy and the replacement by coal of other fossil fuels in short supply. Currently 27 percent of the oil and 64 percent of the natural gas consumed in the United States are used for industrial and electric energy production and could be partially replaced by coal. In addition, oil and natural gas could be synthesized from coal for transportation and heating uses. Currently, western coal would be favored for both of these expanded uses because of its chemical and physical characteristics. However, the distance of the western coal from load centers has spurred research into stack gas sulfur removal, desulfurization of coal, and gasification and liquefaction of eastern coal. Projections for the long term utilization of eastern Montana coal thus are made even more difficult because of this rapidly evolving technology based on traditional coal sources. It is safe to assume, however, that in the short term (10-20 years), there will be continued pressure to develop eastern Montana coal reserves.

Potential Impacts of Coal Development

Quantification of the impact of coal development on the biophysical and socio-economic environment of eastern Montana is extremely difficult. We presently cannot predict the size or impact of the development because many of the technologies for energy conversion have not been developed beyond the pilot plant stage, and baseline socio-economic and environmental data for eastern Montana are currently lacking. In essence, we currently know very little about the potential impact of pending coal development. We can raise many questions, but the answers are scarce.

One of the most critical dimensions of potential environmental impact associated with eastern Montana coal development is the availability and use of water. All of the energy conversion technologies currently proposed for eastern Montana consume enormous quantities of water. The water use associated with the 2100 MW Colstrip generating complex will be 39,000 acre feet per year at peak plant capacity. One acre foot is equivalent to 332,000 gallons. One 250 million SCF per day Lurgi process coal gasification plant is estimated to consume 17,000 acre feet of water per year. The actual amount of water consumed in thermal energy conversion depends to a large degree on the type of process used to remove the waste heat from the system. The most common type of waste heat removal is the "wet tower" cooling system in which the waste heat is transferred to water, some of which is in turn evaporated, cooling the remaining water for reuse. The arid lands of eastern Montana require that water be piped to the site of energy conversion, hence water is often a limiting resource. For example, Montana Power has proposed to build a 36-inch pipeline from the Yellowstone River approximately 30 miles to their plant site at Colstrip.

The 39,000 acre feet of water per year that will be used at the Colstrip generating complex represents only a small fraction of the total annual flow of the Yellowstone River at the point of removal and one would expect that even much larger diversions could be made without affecting the river ecosystem. However, the energy conversion facilities require an essentially constant flow throughout the year, while river flow rates fluctuate seasonally. Low, late summer flows represent only a small percentage of the peak spring flow. It is misleading to look only at annual flows when describing water requirements and potential effects. An abundant spring runoff cannot supply industrial water requirements during a late summer drought. Thus, flow regulation will be necessary if large scale water diversion is to take place on the Yellowstone River.

In April, 1972, the United States Bureau of Reclamation published the Montana/Wyoming Aqueduct Study. This report was prepared "in response to requests by energy fuel authorities and electric power suppliers for information on the amount of water available from existing reservoirs and unregulated streams, as well as potential reservoirs, and to the feasibility of moving large amounts of water from sources to points of possible use." Industry indicated a future demand of 2.6 million acre feet of water and the study concluded that as much as 3.2 million acre feet could be made available annually from the Yellowstone and its tributaries by "full development from existing and potential storage reservoirs and by the construction of aqueducts to transfer water to points of use". Flow regulation on the Yellowstone River would be accomplished either by off-stream storage on tributaries flowing south into the Yellowstone (Buffalo Creek, Cedar Ridge, Sunday Creek) or by on-stream storage through the construction of the Allenspur Reservoir. The Allenspur Reservoir would be built on the Yellowstone River just south of Livingston, and would flood Paradise Valley, the current route of U.S. Highway 89 from Mammoth in Yellowstone National Park to Livingston.

The Montana/Wyoming Aqueduct Study can certainly be described as controversial and construction of the Allenspur dam is considered by many (including the authors) to be environmentally and socially unacceptable. In addition, large scale industrial water diversion limits other water uses such as agriculture and recreation, and could lead to in-stream water quality problems. Some flow regulation on the Yellowstone River is an absolute necessity for the large scale development of eastern Montana coal resources, and the environmental and socioeconomic impacts of this water development must be assessed along with the impact of the coal development itself. A prime concern is the need for a cost-benefit study of the water storage and aqueduct system necessary for consumptive, "wet tower" cooling, thermal generation versus dry cooling, non-consumptive water use with its increased capital and operating costs but greatly reduced water needs.

An almost innumerable number of questions come to mind when considering the environmental and socioeconomic impact of the coal development in eastern Montana. Can long term reclamation be demonstrated on the arid Great Plains? What will be the impact of air and water pollution from industrial development? What will be the impact of development on the existing social and political systems of eastern Montana? Will the increase in revenue due to increased jobs and tax base pay for the increased social, economic, and educational services that will be needed in the area? How long will the development last? What will happen when the development ends? Will the coal development be just another Montana "Boom and Bust"? The list of questions is long; the list of answers is very short.

Planning For The Future

Both the state government of Montana and the federal government are attempting to answer some of these questions. In October, 1972 the United States Department of the Interior announced the Northern Great Plains Resources Program (NGPRP). The primary objective of the NGPRP is "to provide an analytical and informational framework for policy and planning decisions at all levels of government. The end result is intended to be a decision-making tool for federal, state, and local interests who together must plan and manage the area's land and natural resources." The NGPRP is divided into various work groups to study different aspects of the potential development, including regional geology, mineral resources, water, atmospheric aspects, surface resources, and socioeconomic and cultural systems. Although the NGPRP did not begin work in earnest until the spring of 1973, the program is scheduled to produce an operational report by June, 1974. Extension of the study beyond this date is tentative. A memo from Earl Butz, Secretary of Agriculture and Counsellor to the President of the United States, to John Whitaker, Under Secretary of the Interior in April, 1973, suggested that the NGPRP should provide "critical information and a plan *to develop* the coal resources in the Northern Great Plains Area" no later than June 30, 1974. For Secretary Butz the option of not developing Montana coal at this time is not viable.

This may indeed be the situation; however the critical questions to be answered relate to the way, and to the rate at which the coal is developed. Here the state of Montana can exert enormous influence and control.

Efforts by the state of Montana to answer the questions raised by the potential coal development in eastern Montana have taken the form of legislation, the designation of a Montana Energy Advisory Council, and a research proposal by the Montana University System to the National Science Foundation and other federal agencies to study the impact of coal development. The Montana Energy Advisory Council (MEAC), under the direction of Lt. Governor William Christiansen, was created in April, 1973 by Governor Thomas Judge. MEAC, an outgrowth of the State Coal Task Force, is charged with "the identification and clarification of energy-related problems and issues, in the formulation of state goals and objectives, and in the selection and continuous evaluation of state programs and policies. It will serve to locate sources of needed information, to help insure that research is undertaken to gather data in areas where understanding is now lacking." One of the first tasks of the energy advisory council was the designation of priorities of research needs related to the coal development in eastern Montana in cooperation with the Montana University System. The Montana Energy Advisory

Council is expected to play a major role in formulating the state response to the impacts of coal development.

In conclusion, perhaps we should consider the history of Montana. The state has always been an exporter of raw materials. In essence, Montana has been a "colony" with the natural resources of the state exploited for use elsewhere. The development of the coal resources of eastern Montana will unavoidably follow the same pattern. The coal will be mined in Montana and shipped out of the state or converted into a different form of energy which is in turn transported out of the state. This situation is not necessarily bad; however, the decision makers at the state level in Montana must carefully monitor the development to make certain that no adverse economic or social consequences result from the development in either the short or long term. The people of the state of Montana must receive desirable recompense for the exploitation of the coal resources. In other words, the coal development must be carefully controlled and monitored so that a short term gain does not result in long term devastation.

In addition, state coal taxation must be reviewed and perhaps adjusted to control the rate and type of development as well as to generate general fund revenues. Current coal tax levels were arbitrarily conceived and relate more to what coal companies suggested they would accept, than to what could be reasonably levied on the basis of fair return to the state. In contrast, the Resources Indemnity Trust Act (Mont. Rev. Codes 70-801) and the Montana Utility Siting Act of 1973 (Mont. Rev. Codes 84-7001) are significant legislative milestones for Montana. These acts will provide part of the revenue necessary for environmental study and impact appraisal required for rational decision making. We must begin today to answer the important material and human questions related to coal development, so that we are not faced with committed resources and unsolved problems growing exponentially into the future.

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University of Montana
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